

II. REMARKS

Claim 8 has been canceled without prejudice. Claims 1 and 9 have been amended and new claims 12-19 have been added. Specifically, claim 1 has been amended to incorporate the subject matter of claim 8. Therefore, claim 1 now has the same scope as previous claim 8. Claim 1 has also been amended to recite “one or more nozzle membrane sections...” in order to provide antecedent basis for “each nozzle membrane section” recited later in claim 1. Claim 9 has been amended to remove multiple claim dependency. New claims 12-17 have been added to recite the subject matter deleted from previous claim 9.

New claim 18 depends upon independent claim 1 and additionally recites “wherein the flexible but leak-tight separation is a leak-tight vertical membrane” as supported on page 11, lines 2-5, of Applicants’ specification as originally filed. New claim 19 depends upon independent claim 1 and additionally recites “wherein the different liquids are ejected together through the same nozzle membrane section” as supported on page 10, line 30, to page 11, line 10, of Applicants’ specification as originally filed.

The present amendment adds no new matter to the application.

A. The Invention

The present invention pertains broadly to a nozzle body for a liquid spray device for nebulizing a high-viscous liquid substance, such as may be used to nebulize functional liquids, medications, sanitizers, and/or fragrances and the like. In accordance with an embodiment of the present invention, a nozzle body for a liquid spray device for nebulizing a high-viscous liquid substance is provided that includes the features recited by independent claim 1. Various other embodiments, in accordance with the present invention, are recited by the dependent claims.

An advantage of the various embodiments of the present invention is that a nozzle body is provided so that “each nozzle output channel is step-shaped with a wider portion adjacent said space and a thinner portion containing a protrusion section protruding beyond the top surface of said nozzle membrane section.” This structure prevents wetting of the nozzle membrane surface when higher nozzle densities are employed to nebulize liquids of greater viscosity. Furthermore, the various embodiments of the present invention are provided with a space consisting of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through the nozzle membrane section, which advantageously allows for mixing of fluids at the time of nebulization. In this way, fluids may be nebulized together that otherwise cannot be stored together due to chemical incompatibility.

B. The Rejections

Claims 1, 3, 4, 9 and 11 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Hess et al. (EP 1 273 355, hereafter the “Hess’355 Document”) in view of Luginbuhl et al. (U.S. Patent 6,523,762, hereafter the “Luginbuhl Patent”). Claim 2 stands rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of the Hess’355 Document and Luginbuhl Patent, and further in view of Silverbrook (U.S. Patent 6,669,333 B1, hereafter the “Silverbrook Patent”). Claim 5 stands rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of the Hess’355 Document and Luginbuhl, and further in view of Adachi et al. (U.S. Patent Publication No. 2002/ 0158952 A1, hereafter the “Adachi’952 Publication”). Claim 6 stands rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of the Hess’355 Document and Luginbuhl, and further in view of Koto (U.S. Patent 4,434,430, hereafter the “Koto Patent”). Claim 7 stands rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of the Hess’355 Document and Luginbuhl, and

further in view of Hartman (U.S. Patent Publication No. 2003/0085966 A1, hereafter the “Hartman Patent”). Claim 8 stands rejected under 35 U.S.C. § 103(a) as unpatentable over the combined teachings of the Hess’355 Document and Luginbuhl, and further in view of Koizumi et al. (U.S. Patent 5,900,894, hereafter the “Koizumi Patent”) and Iida (U.S. Patent Application Publication No. 2001/0006396, hereafter the “Iida Publication”). Claim 10 stands rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of the Hess’355 Document and Luginbuhl, and further in view of Adachi et al. (U.S. Patent Publication No. 2003/ 0107159 A1, hereafter the “Adachi’159 Publication”).

Applicants respectfully traverse the Examiner’s rejections and request reconsideration of the above-captioned application for the following reasons.

C. Applicants’ Arguments

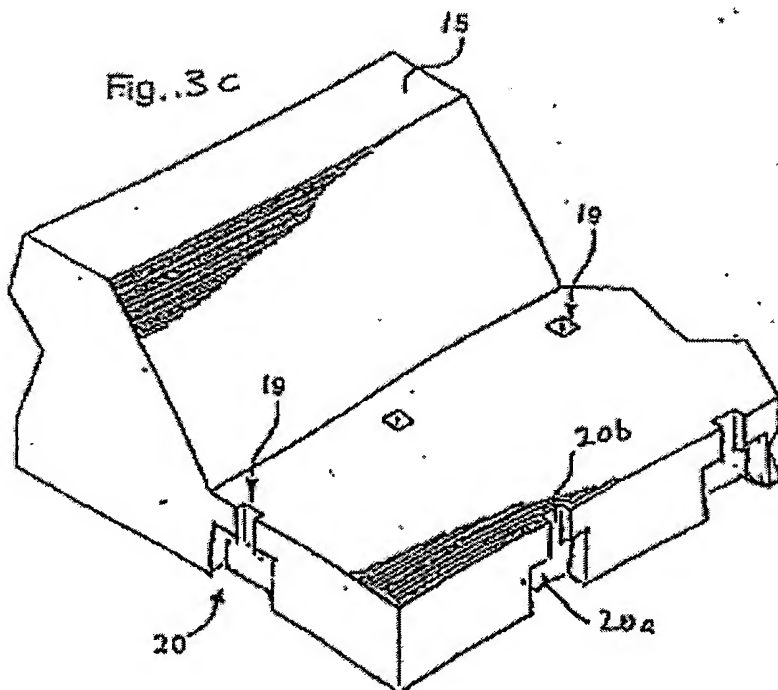
A prima facie case of obviousness requires a showing that the prior art teaches each and every element of the claimed invention, and that the prior art provides some teaching, suggestion or motivation to combine the references to produce the claimed invention. In re Oetiker, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992); In re Vaeck, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). In this case, none of the documents of record teach, or suggest, the “space consists of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1; therefore, all combinations of teachings from these documents fail to establish a prima facie case of obviousness against the instant claims.

i. The Hess’355 Document

The Hess’355 Document discloses a “method of manufacturing a liquid droplet spray device and such spray device,” wherein a liquid droplet spray device, as shown in Figures 3a,

3b, 3c, is manufactured so as to include a first substrate (15), a space (12) within the housing for containing the supplied liquid substance, and outlet means arranged in the first substrate (15) and including outlet nozzles (19) and stepped output channels (20). As shown in Figure 3c reproduced below, the output channels (20) have straight side walls with a lower portion (20a) and an upper portion (20b). As also shown in Figure 3c, the lower portion (20a) is adjacent to the space (12) and is larger in diameter than the upper portion (20b). The Hess'355 Document also discloses that there is a vibrating element (18) for vibrating liquid so as to eject it (See Abstract).

However, it is plain from Figure 3c, reproduced below, that the device disclosed by the Hess'355 Document does not include a "thinner portion containing a protrusion section protruding beyond the top surface of said nozzle membrane section" as recited by independent claim 1.



The Examiner has conceded that the Hess'355 Document does not teach, or suggest, a "protrusion section" as recited in independent claim 1 (Office Action, dated October 2, 2006, at 3, lines 11-14).

As also admitted by the Examiner, the Hess'355 Document does not teach, or suggest, that a "space consists of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section" as recited by independent claim 1 (Office Action, dated October 2, 2006, at 7, lines 4-7).

As further admitted by the Examiner, the Hess'355 Document does not teach, or suggest, the subject matter of claims 2-7 and 10 (Office Action, dated March 15, 2005, at 4, lines 13, to at 7, line 18; Office Action, dated October 2, 2006, at 4, line 11, to at 6, line 20, and at 8, lines 1-3). With respect to claims 3 and 4, the Examiner contends that it would have been obvious to a person of ordinary skill in the art to discover the optimum value of a result effective variable, such as the nozzle density per area, and cites In re Boesch, 205 U.S.P.Q. 215 (C.C.P.A. 1980) in support of this contention (Office Action, dated March 15, 2006, at 5, lines 1-10; and Office Action, dated October 2, 2006, at 5, lines 1-7). However, the Examiner has misapplied Boesch to this case.

In Boesch, 205 U.S.P.Q. at 216-218, the invention was a nickel base alloy and the prior art patent taught alloy composition tables. The court concluded that, because the compositions taught by the prior art overlapped the compositions of the claims, that it would have been obvious to discover the optimum value of the electron hole number (N_v) in order to avoid embrittling metal phases (i.e., the sigma phase). Boesch, 205 U.S.P.Q. at 219.

In this case, there is no overlap between the nozzle density taught by the Hess'355 Document and the nozzle density as claimed in claims 3 and 4. For this reason alone, the rule of Boesch does not apply.

For all of the above reasons, the Hess'355 Document fails to anticipate or render obvious the subject matter recited by independent claim 1, or any other claim, of the above-captioned application.

ii. The Luginbuhl Patent

The Luginbuhl Patent discloses a “micromechanically produced nozzle for producing reproducible droplets” that consists of a liquid container delimited by a silicon structure (1) and a pyrex structure (13), (See Abstract of the Luginbuhl Patent and Figure 1). The Luginbuhl Patent discloses that the silicon structure (1) is a silicon wafer consisting of a silicon oxide layer (SiO_2) and a silicon nitride layer (Si_3N_4) and that the wafer has a nozzle of silicon oxide (SiO_3), see (12) in Figure 1, which forms a nozzle opening (22) of a liquid container (21), (See Figure 1 and Abstract). The liquid is fed into the liquid container (21) through a channel formed in the pyrex structure (See Abstract). A disk (20) made of a piezoelectric material exerts a pressure on the liquid in the container, which passes through the nozzle in the form of a drop (See Abstract). In Figure 6, the Luginbuhl Patent discloses that the nozzle (12) may be provided with a layer of silicon oxide (25), (col. 3, lines 41-45).

The Luginbuhl Patent does not teach, or suggest, the “space consists of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1.

iii. The Koizumi Patent

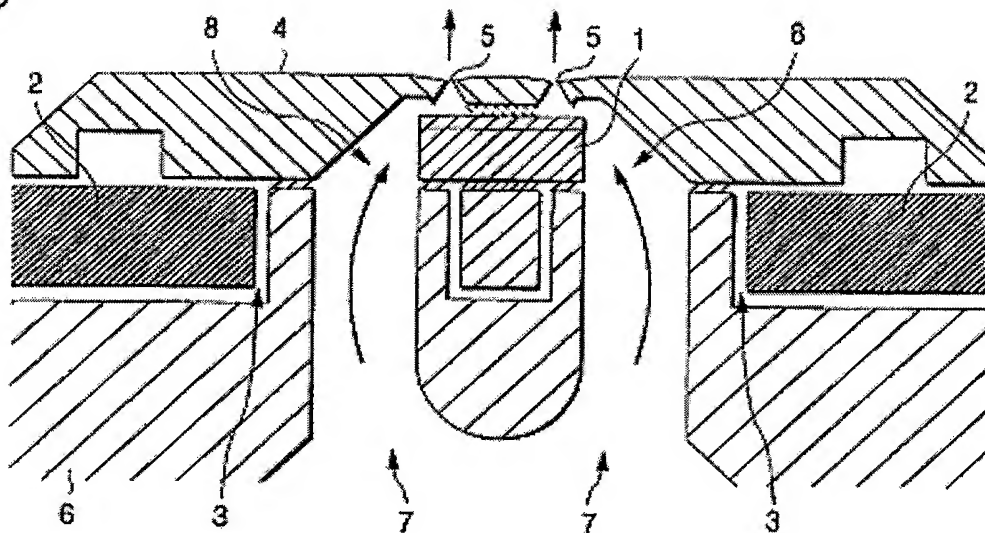
The Koizumi Patent discloses an “ink jet print head, method for manufacturing the same, and ink jet recording device” that uses a seal material (46), made of silicone (col. 14, line 18, to col. 15, line 10). As evident from Figures 12E and 14A of Koizumi, the seal material (46) does not form a “flexible but leak-tight separation” as recited in claim 8 of the present application. The Koizumi Patent simply does not teach, or even suggest, that its

silicon seal (46) is flexible. On the contrary, a person of ordinary skill in the art would recognize that the seal (46) would be rigid and not flexible.

The Examiner contends that the Koizumi Patent teaches “a space consisting of at least two sub-spaces separated by a leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane” (Office Action, dated October 2, 2006, at 7, lines 8-10). Applicants disagree for the following reasons.

The portion of the Koizumi Patent referred to by the Examiner (i.e., col. 14, line 18, to col. 15, line 10) is directed to embodiments shown in Figures 12E and 13A to 13C. None of these embodiments have a “space consist[ing] of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1. In fact, the Koizumi Patent explicitly teaches in Figure 16, reproduced below, two ink supply pipes (7), which may be supplied with two different color inks (col. 17, lines 30-36). However,

FIG. 16



as evident from Figure 16, each supply pipe (7) has its own ink supply chamber (8) and its own injection port (5) so that ink from each supply pipe (7) is sprayed separately from one another. The structure shown in Figure 16 of the Koizumi Patent is substantially different

from that of the presently claimed invention because a person of ordinary skill in the art would realize that the unlabeled “separation” shown in Figure 16, between supply pipes (7), is not “leak-tight” and is not “flexible” as recited in independent claim 1. Furthermore, while the structure shown by the Koizumi Patent may eject ink from the supply pipes at the same time, it does so separately, but not together. The “flexible but leak-tight separation” recited by claim 1 makes it possible for the nozzle body of the present invention to eject different liquids together through the nozzle membrane section.

The Koizumi Patent also does not teach, or suggest, a “thinner portion containing a protrusion section protruding beyond the top surface of said nozzle membrane section” as recited by independent claim 1, and “wherein the different liquids are ejected together through the same nozzle membrane section” as recited by new claim 19.

iv. The Iida Publication

The Iida Publication discloses an “ink cartridge for an ink jet printer” that is provided with a container (1) having at least a first wall (1a) and an ink supply port (2) formed through the first wall for supplying ink to the exterior of the container (See Abstract of Iida Publication, and Figure 1). Iida also discloses that an ink chamber (4) and an ink supply chamber (5) are formed by a membrane valve seat (3) made of an elastic thin membrane and formed with a through hole (6) therethrough (See Abstract and Figure 1). The Iida Publication further discloses that a valve body (8) is positioned opposing the through hole (6) formed in the membrane valve seat (3), and the valve body (8) and membrane valve seat (3) adjacent the through hole (6) formed therein are maintained selectively in contact by a pressure difference between the ink chamber (4) and the ink supply chamber (5), (See Abstract).

However, the Iida Publication does not teach, or even suggest, a “space consist[ing] of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1. In fact, the membrane valve seat (3) disclosed by Iida has a hole (6) in it. It is designed to leak. Consequently, the Iida Publication does not teach, or even suggest, a “leak-tight” separation.

A person of ordinary skill in the art would realize that the different chambers (i.e., ink chamber (4) and ink supply chamber (5)) disclosed by the Iida Publication contain the same ink and not different inks. Therefore, the Iida Publication does not teach, or suggest, that the membrane valve seat (3) forms different sub-spaces, “each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1.

The Iida Publication also does not teach, or suggest, a “thinner portion containing a protrusion section protruding beyond the top surface of said nozzle membrane section” as recited by independent claim 1.

v. The Silverbrook Patent

The Silverbrook Patent discloses “stacked heater elements in a thermal ink jet printhead,” as shown in Figure 1, wherein a unit cell (1) of a printhead includes a nozzle plate (2), a nozzle (3) having nozzle rim (4) and aperture (5) extending through the nozzle plate (2). When the printhead is in use, the device disclosed by the Silverbrook Patent uses a heater element (10) to give a thermal pulse to ink that has flowed from a reservoir (not shown) to chamber (7) via inlet passage (9) to fill the chamber to a predetermined level (col. 5, lines 33-42). However, the Silverbrook Patent does not teach, or suggest, a “thinner portion containing a protrusion section protruding beyond the top surface of said nozzle

membrane section” and the “space consists of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1.

The Silverbrook Patent discloses one nozzle (3) per unit cell (1) as shown in Figure 1. The Hess’355 Document discloses multiple outlet nozzles (19) per substrate (15). A person of ordinary skill in the art would realize that increased nozzle density in the context of an “array of outlet nozzles” connected to one “enclosed space,” as recited in claim 1, increases flow rate by generating larger droplets, which would diminish the quality of a printed image. Consequently, a person of ordinary skill in the art would have no reason to combine the subject matter of the Silverbrook Patent with that of the Hess’355 Document.

The Silverbrook Patent also does not teach, or suggest, a “space consist[ing] of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1.

vi. The Adachi’952 Publication

The Adachi’952 Publication discloses “ink for ink jet recording and inkjet recording method,” wherein the ink has a viscosity of “preferably 30 mPas or less...more preferably 30 mPas” (paragraph [0073]). A person of ordinary skill in the art would realize that the Adachi’952 Publication discloses ink viscosity around 30 mPas. The Adachi’952 Publication does not teach, or suggest, viscosity of a liquid substance “of at least 5 mPas” as recited by claim 5. The Adachi’952 Publication also does not teach, or suggest, a “thinner portion containing a protrusion section protruding beyond the top surface of said nozzle membrane section” and a “space consist[ing] of at least two sub-spaces separated by a flexible but leak-

tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1.

vii. The Koto Patent

The Koto Patent teaches an “ink jet printer head” that includes first and second substrates coupled together to form one nozzle, pressure chamber and passageway (See Claim 6 of the Koto Patent). A person of ordinary skill in the art would realize that this coupling of two substrates requires some form of bonding, gluing or welding, which does not meet the limitation of claim 6 “wherein said first and second substrates are formed integrally from one substrate by machining.” The Koto Patent also does not teach, or suggest, a “thinner portion containing a protrusion section protruding beyond the top surface of said nozzle membrane section” and a “space consist[ing] of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1.

viii. The Hartmann Publication

The Hartman Publication discloses “reserve ink supply in thermal ink jet cartridge ink tanks” wherein, as shown in Figure 1, an ink cartridge includes a foam chamber (12) for storing a porous member such as a foam material or compressed porous material impregnated with ink (paragraph [0024]). However, the Hartman Publication does not teach, or suggest, a “thinner portion containing a protrusion section protruding beyond the top surface of said nozzle membrane section” and a “space consist[ing] of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1.

ix. **The Adachi'159 Publication**

The Adachi'159 Publication discloses a “bonding method” wherein a vibration plate (32) is molded with an ink chamber (31) using molds (31') and (32'), (paragraph [0057]).

The Adachi'159 Publication is completely silent with respect to a “vibrating element...attached to said nozzle body through removable attachment means” as recited in claim 10. The vibration plate disclosed by the Adachi'159 Publication is neither a “vibrating element” as recited in claim 10 nor a “piezoelectric element” as recited in claim 11. Also, because the vibration plate (32) is molded into place as taught by the Adachi'159 Publication, the vibration plate (32) is not attached to a “nozzle body through removable attachment means” as recited in claim 10.

The Adachi'159 Publication also does not teach, or suggest, a “thinner portion containing a protrusion section protruding beyond the top surface of said nozzle membrane section” and a “space consist[ing] of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1.

In sum, neither the Hess'355 Document, the Luginbuhl Patent, the Koizumi Patent, the Iida Publication, the Silverbrook Patent, the Adachi'952 Publication, the Koto Patent, the Hartmann Publication, nor the Adachi'159 Publication teach, or suggest, the “space consist[ing] of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1. On the contrary, the Iida Publication teaches a membrane valve seat (3) that has a hole (6) formed therein because the membrane valve seat (3) must “leak” in order to operate properly. Therefore, the Examiner has not established a prima facie case of obviousness against the instant claims because the combined teachings of

the documents cited by the Examiner does not teach each and every limitation of the claimed invention.

Furthermore, the Examiner has misconstrued the teachings of (i) the Koto Patent, which does not teach first and second substrates “formed integrally from one substrate by machining” as recited by claim 6, and (ii) the Adachi’159 Publication, which does not teach a “vibrating element...attached to said nozzle body through removable attachment means” as recited in claim 10.

Also, the teachings of the Silverbrook Patent, which relate to an inkjet printer head, are not combinable with those of the Hess’355 Document, which relates to liquid droplet spray device for nebulizing liquids, because inkjet printers employ one nozzle per ink chamber, whereas the device of the Hess’355 Document employs an array of nozzles per liquid chamber, and because the technology employed by the Hess’355 Document would diminish the quality of images produced by an inkjet printer.

III. CONCLUSION

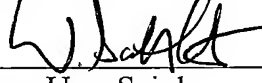
The Examiner has not established a prima facie case of obviousness against claims 1-7 and 9-19 of the present application because neither the Hess’355 Document, the Luginbuhl Patent, the Koizumi Patent, the Iida Publication, the Silverbrook Patent, the Adachi’952 Publication, the Koto Patent, the Hartmann Publication, nor the Adachi’159 Publication teach, or suggest, the “space consist[ing] of at least two sub-spaces separated by a flexible but leak-tight separation, each sub-space containing a different liquid to be ejected together through said nozzle membrane section” as recited by independent claim 1, and that “the flexible but leak-tight separation is a leak-tight vertical membrane” as recited in claim 18, and that “wherein the different liquids are ejected together through the same nozzle membrane section” as recited in claim 19.

For all of the above reasons, claims 1-7 and 9-19 are in condition for allowance and a prompt notice of allowance is earnestly solicited.

Questions are welcomed by the below-signed attorney for Applicants.

Respectfully submitted,

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